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Course: Computer Graphics
Course Code: CS6401
Date: 09/03/22

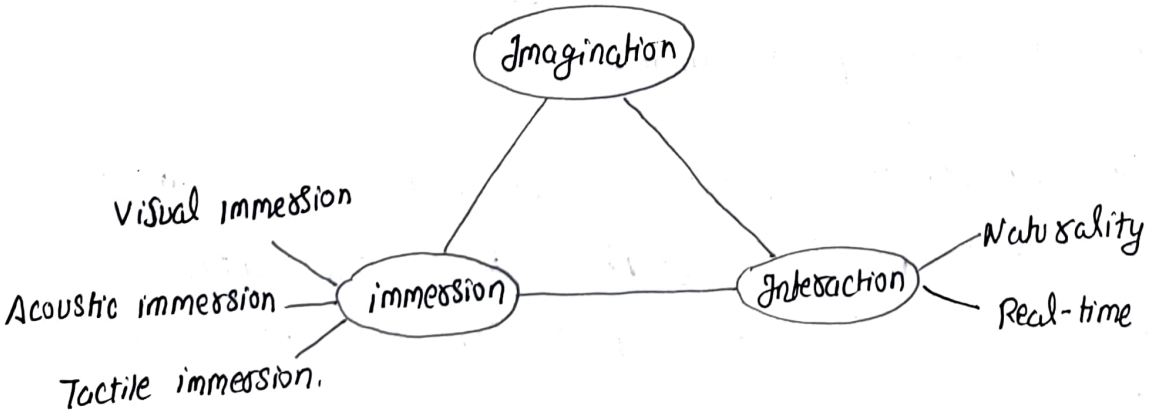
Solution 1>

i> Computer Graphics:-

Computer graphics is a way to communicate the processed information to user, It is used to display the information in form of pictures and charts, graphs and diagrams instead of simple text. In Computer graphics discrete picture elements called pixels are used to represent pictures or other graphics objects.

ii> Virtual Reality Triangle:

Virtual Reality is the use of Computer modelling and simulating that enables a person to interact with an artificial three-dimensional (3-D) visual or other sensory environment. It is a Computer-simulated reality which replicates an environment, reality which replicates on or imagined and simulates a user's physical presence and envisoment to allow for user interaction.



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iii) Frame: Frame are rectangular area meant for inserting graphics and text. They allow users to place objects whenever they want on page.

iv) Frame Buffer: In raster display a special area of memory is dedicated to graphics only. This memory area is called frame buffer. It holds the set of intensity values for all the screen point.

vii) Resolution & Aspect-ratio: The resolution of an image is the total number of pixels displayed on your computer or television screen.

Aspect ratio is the ratio of the width of an image to the height of image (x:y)

viii) Anti-aliasing :- Anti-aliasing is the smoothening of edge & colors in digital images and fonts. It makes edge appears less jagged and help blend colors in a natural looking way.

v) Scan-line: It is one-line or row in a raster searching pattern. Such as line of video on a (CRT) display of a television set or computer monitor.

vi) Scan-Conversion: It is a process of representing graphics objects a collection of pixels. The graphics objects are continuous. The pixels used are discrete. Each pixel can have either on or off state.

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3.

ix) Mixed reality system: Mixed Reality (MR) is the merging of real and virtual worlds to produce new environments and visualizations, where physical and digital objects co-exist and interact in real time.

x) Interactive and passive graphics:

There are basically two types of Computer graphics namely interactive Computer Graphics (ICG) and passive Computer Graphics. The major difference over the two types it is that while in interactive Computer graphics users can interact with graphics and can make changes in them, he cannot do so in passive Computer graphics i.e. he has no control over the images.

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Solution 2:>

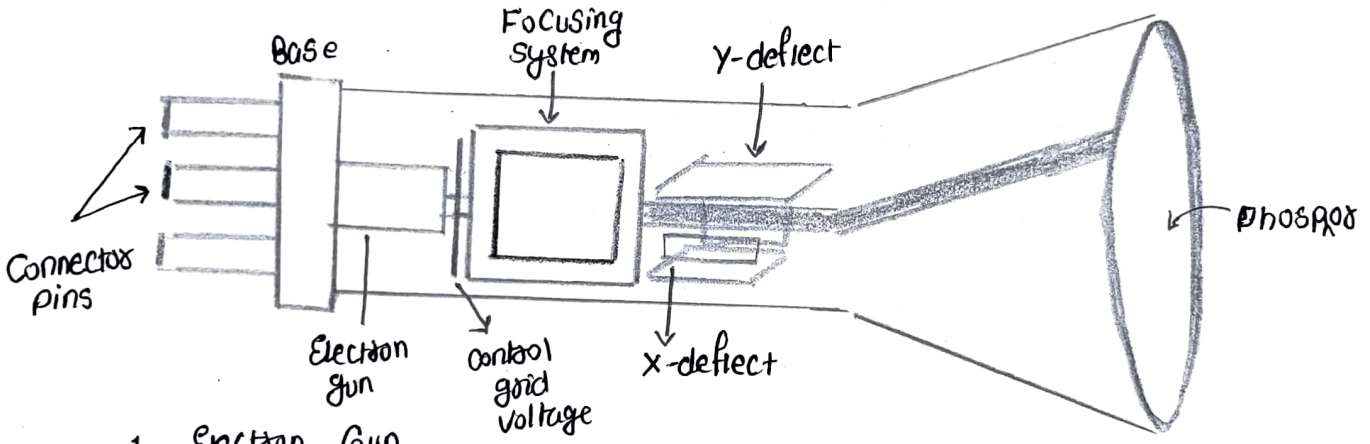
4.

Cathode Ray Tube (CRT)

A CRT is an electronic tube designed to display electrical data.

The basic CRT consists of four major components.

1. Electron Gun
2. Focussing & Accelerating Anodes
3. Horizontal & vertical Deflection plates.



1. Electron Gun.

It is used for producing a stream of electrons.

2. Focussing & Accelerating Anodes.

These are used for producing a narrow and sharply focus beam of electrons.

4. Horizontal and Vertical Deflection plates.

These are used for controlling the path of the beam.

5. Evacuated Glass Envelope

With a phosphorecent screen which produces bright spot when struct by a high velocity electron beam.

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5.

Working of CRT:

Heater element is energized by alternating current to obtain high emission of electron from cathode. Control grid is biased negative with respect to cathode it controls the density of electron beam to focus the electron beam on the screen focusing anode is used. the focusing anode operate at a potential of twelve hundred (1200V) and accelerating anode at 2000V to accelerate the electron beam.

Two pairs of deflection plates provided in the CRT these deflection plates are mounted at right angle to each other to provide electrol beam deflection along vertical and horizontal axis of the screen. The screen consists of a glass which is coated by some florescent material lie Zinc Silicate. When high velocity electron beam structs the phosphorescent screen the light emitts from it. The property of phosphor to emitt light when its atoms are excited is called fluorescence.

→ **Normal CRT**: A black & white CRT has the tube face coated inside a with a continuous layer of a single phosphor. The phosphor can be any of a variety of colours - bluish-white for television images. but green or ~~orange~~ orange or blue for CRT terminals and other data display.

→ **Colored CRT**: A CRT monitor displays color pictures by using a combination of phosphors that emit different-coloured light. The emitted light from the different phosphors merge to form a single perceived color, which depends on the particular set of phosphors that have been excited.

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Solution : 3

Video Controllers is used to Control the operation of display . A fixed area of system memory is reserved for the frame buffer and video Controllers is given direct access to frame buffer memory.

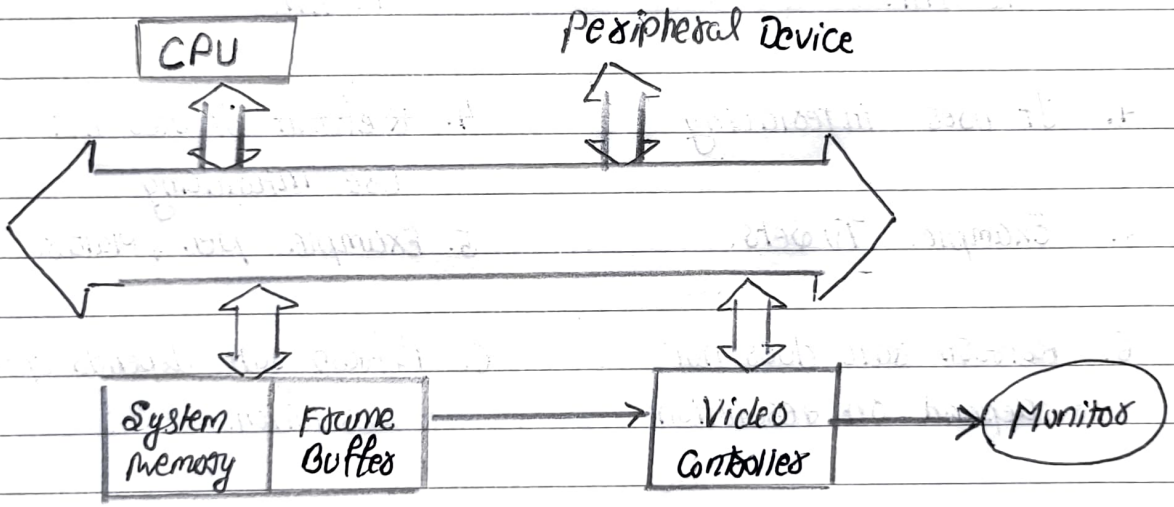


Diagram 1.1 Architecture of a raster system with a fixed portion of the system memory used for frame buffer.

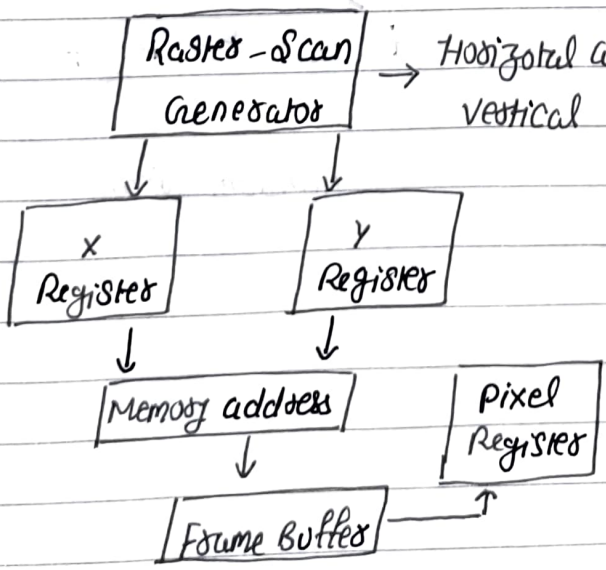
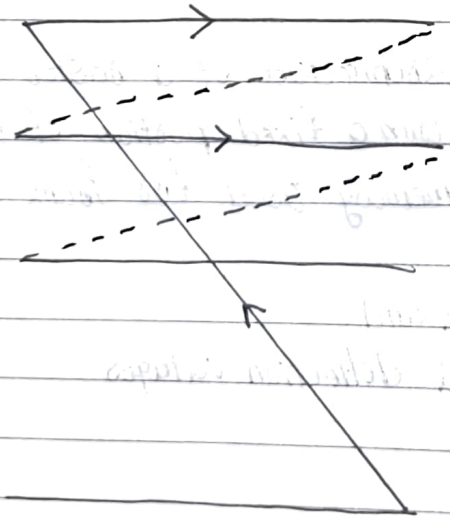


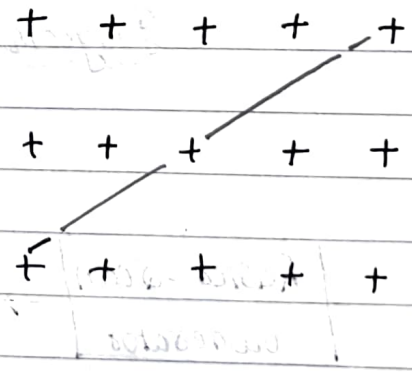
Fig: Basic video-Controller regular operations.

Solution 3: Continue...

Raster Scan	Random Scan.
1. low Resolution	1. High Resolution.
2. less expensive	2. More Expensive
3. Solid pattern is easy to fill.	3. Solid pattern is tough to fill.
4. It uses interlacing	4. ~~Refresh~~ It does not use interlacing
5. Example. Tv sets.	5. Example. pen, plotter.
6. Refresh rate does not depend on resolution	6. Refresh rate depends upon Resolution.



Raster Scan



Random Scan.

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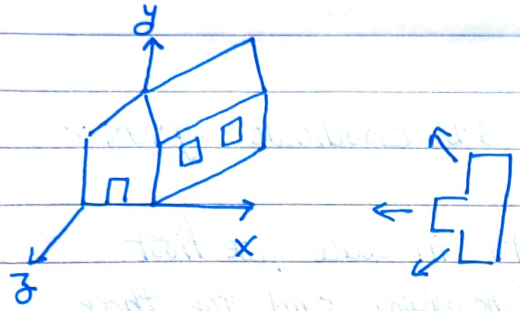
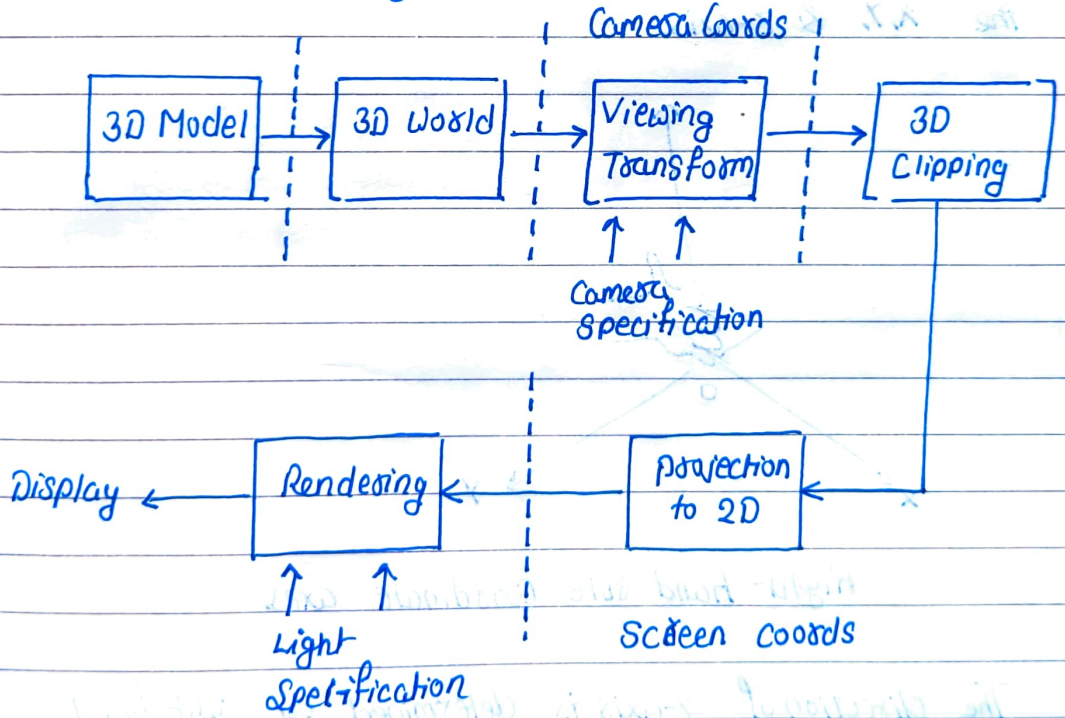
Solution 4> For three-dimensional graphics applications, first of all, we can view object from any spatial position: from the front. From above or from the back.



Photography scene involves selection of a camera position and orientation

The Viewing Pipeline.



: The steps for computer generation of a view of the three dimensional scene are somewhat analogous to process involved in taking a photograph.

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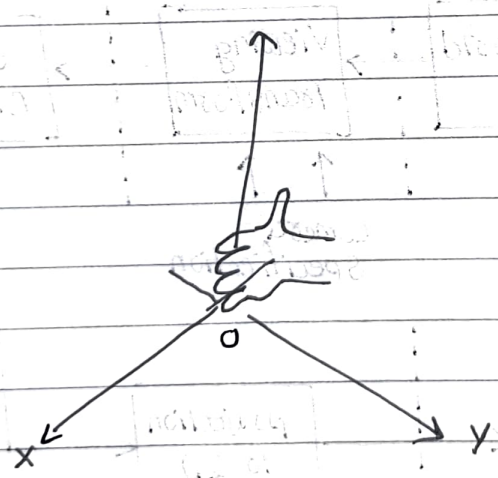
To take a snapshot, we need to first position the camera at a particular point in space. Then we need to decide the camera orientation.

Thumb rules for representing 3-D coordinate system :-

In order to represent points in space, we first choose a fixed point O (the origin) and the three directed lines through O they are perpendicular to each other, called the coordinate axes and labelled the x, y, & z-axis.

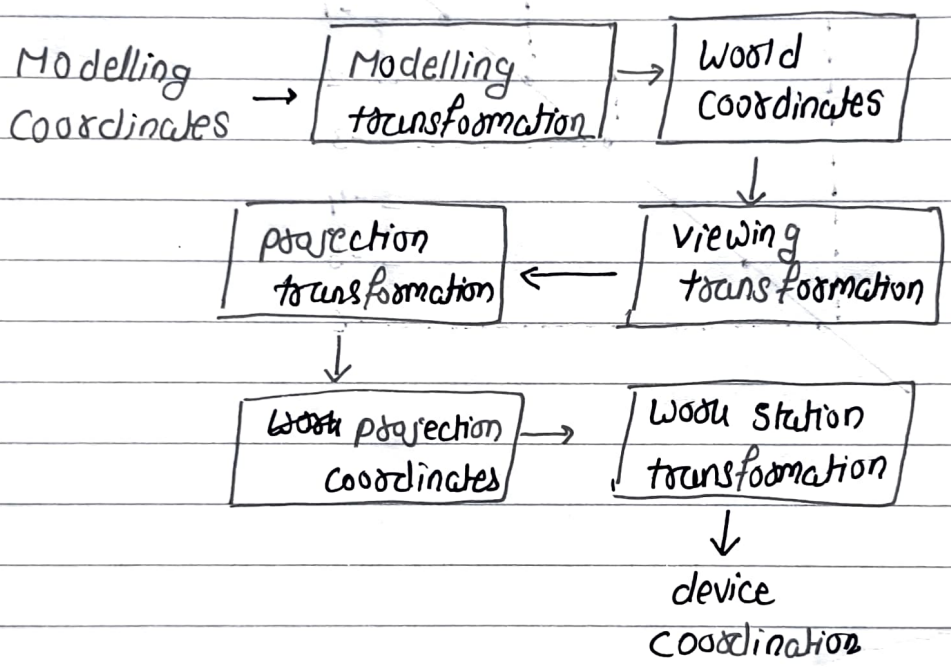


Right hand rule coordinate axes.

The direction of z-axis is determined by right hand thumb rule :-

If you curl the fingers of your right hand around

the z-axis in the dir^n of a 90° counter clockwise rotation from the positive x-axis to positive Y-axis ; then yours thumb points in the +ve dir^n of z-axis.



General 3D transformation Pipeline

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Solution 5:

Difference between DDA and Bresenham's line algorithms.

DDA Algorithm	Bresenham's line Algorithm.
1. DDA Algorithm use floating point, i.e. Real arithmetic.	1. It uses Line algorithm use fixed point i.e. Integer Arithmetic.
2. DDA Algorithm uses multiplication & division its operation	2. It uses only subtraction and addition its operation
3. It is slowly than Bresenham's line algorithm in line drawing because it uses real arithmetic (Floating point operation).	3. It is faster than DDA Algorithm in line because it involves only addition & subtraction in its calculation.
4. It is not accurate and efficient as Bresenham's line algorithm.	4. It is more accurate and efficient at DDA Algorithm.

* Consider the line from (0,0) to (-6,-6)

To do: use simple DDA Algorithm and find intermediate points to rasterize the line segments.

Let us perform some initial calculations.

Initially $X_1 = 0$, $Y_1 = 0$, $X_2 = -6$, $Y_2 = -6$.

So our first step would be to evaluate the length.

length = abs(-6 - 0) = 6
length = abs(-6 - 0) = 6

So length = 6 (in any x or y direction)

$$\Delta x = (x_2 - x_1)/length = \frac{-6-0}{6} = -1$$

$$\Delta y = (y_2 - y_1)/length = \frac{-6-0}{6} = -1$$

$$x = x_1 + 0.5 * Sign(\Delta x)$$

$$= 0 + 0.5 * (-1)$$

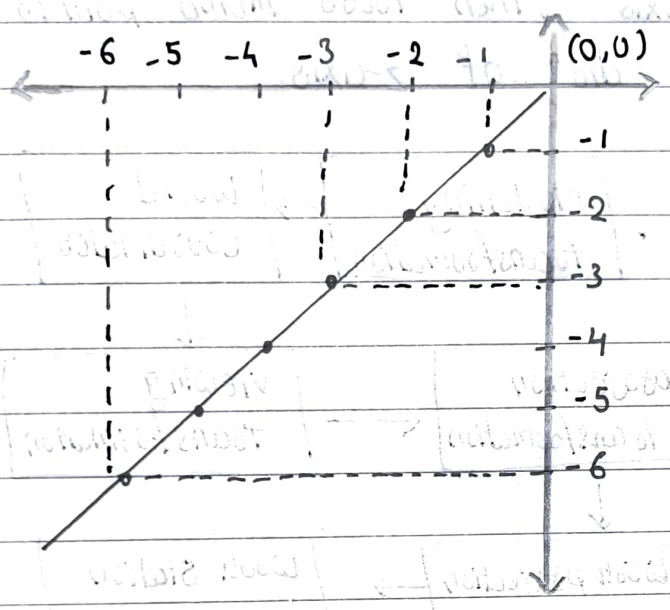
$$[x = -0.5]$$

Similarly, we have $[y = -0.5]$

→ Evaluating through main loop gives us.

1	plot	x (Round off)	y (Round off)
1	(0,0)	-0.5 = 0	-0.5 = 0
2	(-1,-1)	-1.5 = -1	-1.5 = -1
3	(-2,-2)	-2.5 = -2	-2.5 = -2
4	(-3,-3)	-3.5 = -3	-3.5 = -3
5	(-4,-4)	-4.5 = -4	-4.5 = -4
6	(-5,-5)	-5.5 = -5	-5.5 = -5
7	(-6,-6)	-6.5 = -6	-6.5 = -6
8	(-7,-7)	-7.5 = -7	-7.5 = -7

So rounding of x_{p+1} and y_{p+1} and let's draw a rough graph for final intution.



1906055.

Solution 6) B)

Flood-fill algorithm	Boundary-fill Algorithm.
1. It requires huge amount of memory.	1. Memory consumption is relatively low in Boundary-fill algorithm.
2. Flood-fill algorithms are simple and efficient.	2. The complexity of boundary-fill algorithm is high.
3. It can process the image containing more than one boundary colours.	3. It can only process the image containing single colour boundary.
4. It is comparatively slower than Boundary-fill.	4. It is faster than flood-fill algorithm.

Mid-Point Ellipse Algorithm :-

- Take input radius along x-axis and y-axis and obtain center of ellipse.
- Initially we assume ellipse to be centered at origin and the first point as: $(x_0, y_0) = (0, r_y)$.
- Obtain the initial decision parameter for region 1 as $P1_0 = r_y^2 + 1/4\, r_x^2 - r_x^2 r_y$
- For every x_k position in region 1:

  If $P1_k < 0$ then the next point along the line is (x_{k+1}, y_k) and $P1_{k+1} = P1_k + 2r_y^2 x_{k+1} + r_y^2$.

  Else. the next point is (x_{k+1}, y_{k-1})

  And $P1_{k+1} = P1_k + 2 r_y^2 x_{k+1} - 2 r_x^2 y_{k+1} + r_y^2$
- Obtain the initial value in region 2 using the last point (x_0, y_0) of region 1 as:

  $P2_0 = r_y^2 (x_0 + 1/2)^2 + r_x^2 (y_0 - 1)^2 - r_x^2 y^2$

6. At each y_k in region 2 starting at $k = 0$ perform the following tasm.

   If $p2_k > 0$ the next point is (x_k, y_{k-1}) and $p2_{k+1} = p2_k - 2r_x^2 y_{k+1} + x_x^2$

7. Else, the next point is (x_{k+1}, y_{k-1}) and $p2_{k+1} = p2_k + 2ry^2 x_{k+1} - 2r_x^2 y_{k+1} + x_x^2$.

8. Now, obtain the symmetric points in the three quadrants and plot the coordinate value as:

   $x = x + xc$, $y = y + yc$.

9. Repeat the steps for region 1 until $2r_y^2 x >= 2r_x^2 y$,